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CHARACTERIZATION OF LOW EARTH ORBIT DYNAMICS BY PERTURBATION FREQUENCY ANALYSIS.

Abstract

As part of the deep dynamical analysis of debris orbits carried out within the H2020 ReDSHIFT project, we present a characterization of the orbital elements of low-altitude objects in terms of their periodic components. Considering a representative sample of possible initial orbital conditions in the Low Earth Orbit (LEO) region, we propagated the dynamics of the objects over a suitable time span. The dynamical model includes the effects of geopotential up to degree and order 5, lunisolar perturbations, solar radiation pressure and atmospheric drag. We further accounted for different values of the area-to-mass ratio of the debris. Then, we decomposed the resulting quasi-periodic series in their spectral components by a numerical computation of Fourier transforms, accounting for the finite duration of the signals. The aim of this spectral analysis is to clearly link each frequency signature to the dynamical effect which originates it in order to build a frequency chart of the LEO region.

Indeed, the detailed analysis of the principal spectral components turns out to be a powerful tool to enable a better understanding of the relative importance of each specific gravititational and non-gravitational perturbation in the LEO region as a function of the initial semi-major axis, eccentricity and inclination of the debris.

Ultimately, the analysis will be used, together with the cartography of the LEO phase space, to identify the most suitable perturbations to be exploited to facilitate the passive "dynamical de-orbiting" of spaceraft at the end of life.

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